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11. WAG 10, OU 10-02, OMRE-01, OMRE LEACH POND

11.1 Site Description

The Organic-Moderated Reactor Experiment (OMRE) leach pond was used for wastewater disposal from the OMRE reactor. The reactor, which operated from 1957 to 1963, was located approximately 3.25 km (2 mi) east of the Central Facilities Area (CFA). Figure 11-1 shows an aerial photograph of the overall OMRE area in 1961. Figure 11-2 shows the OMRE area wells, recent sampling locations, and the results of a radiometric scanning survey. The pond was located approximately 91 m (300 ft) east of the OMRE facility and was a shallow depression surrounded by an earthen berm. Pond dimensions at the berm top were approximately 8 × 22 m (26 × 72 ft) and at the base were approximately 5 × 15 m (16 × 49 ft). Soil depth to basalt in the base varied from 30 cm (12 in.) at the east end, to 46 cm (18 in.) at the west end (Chapin 1979). A portion of the pond soil was excavated in 1979 and sent to the Radioactive Waste Management Complex (RWMC). However, the cleanup goal was 1,000 pCi/g, and it is thought that the contaminated soil up to this limit was left in place. The pond has since been backfilled, and the entire area is revegetated with grass. The former pond location was identified in 1997 as a slightly mounded area with more lush vegetation.

During OMRE operations, reactor wastewater sent to the pond either evaporated or infiltrated the ground. Suspected contaminants in the pond were primarily short-lived radionuclides, metals, and organics. The coolant organics were generally associated with high boiling components similar to wax, however, neutron bombardment was expected to have decomposed some components to low boiling point organics, including benzene, toluene, ethylbenzene, and xylene (BTEX) (Chapin 1979). It was presumed that a high percentage of the liquids that were discharged into the OMRE pond flowed into basalt fractures. This was based on a 1979 decontamination and decommissioning (D&D) report (Chapin 1979). As a result, the OMRE pond is considered a potential source for groundwater contamination.

11.2 Previous Investigations

The leach pond area underwent D&D in the late 1970s. In 1979, during D&D characterization, radionuclide contamination was found throughout the sediment underlying the pond and pond berm. Researchers did not analyze other constituents at that time, and no validated sample results are available. The D&D characterization report suggested that only portions of the pond base (based on a cleanup goal of 1000 pCi/g) needed to be excavated (Chapin 1979). It was thought that the D&D completed a partial excavation and backfilled the excavation with soil. However, no final D&D report was written, and no verification data were identified that were specific to the leach pond.

During the 1988 U.S. Department of Energy (DOE) Environmental Survey, three grab samples were collected from the pond sediments approximately 0.31 m (1 ft) above the basalt. The precise location where these samples were collected is unknown. No sample results were identified in the Environmental Restoration Information System (ERIS) or Waste Area Group (WAG) 10 databases, but hard copies were available in the DOE report. Seven metals of interest were detected in the samples at levels assumed to be similar to background levels. Bis(2-ethylhexyl phthalate) was detected in one sample, but concentrations of tentatively identified compounds (TICs) were estimated at 6,400 ppb in that sample. Methylene chloride and 1,1,1-TCA were detected in all three samples at levels less than 100 ppb.

Originally scheduled for a Track 2 investigation under Operable Unit (OU) 10-02, the OMRE leach pond was instead investigated under the OU 10-04 remedial investigation (RI)/feasibility study (FS) and was sampled during the summer of 1997. Sampling included a passive soil-gas survey to detect semi-volatile organic compounds (SVOCs) and volatile organic compounds (VOCs) in the subsurface, and

collection of soil samples for radionuclide and metals analyses from several depth increments in nine boreholes that were hand augered down to the basalt bedrock. In addition, using hand-held radiation detection and global positioning system (GPS) instruments, the coordinates of radioactive hot spots in the surface soil were entered into the ERIS database. The Environmental Monitoring Program, which had conducted annual radiation surveys of OMRE for several years prior to 1997, indicated that all the surficial radiological hot spots had been previously identified and none had generally exceeded 1 mrem/hr.

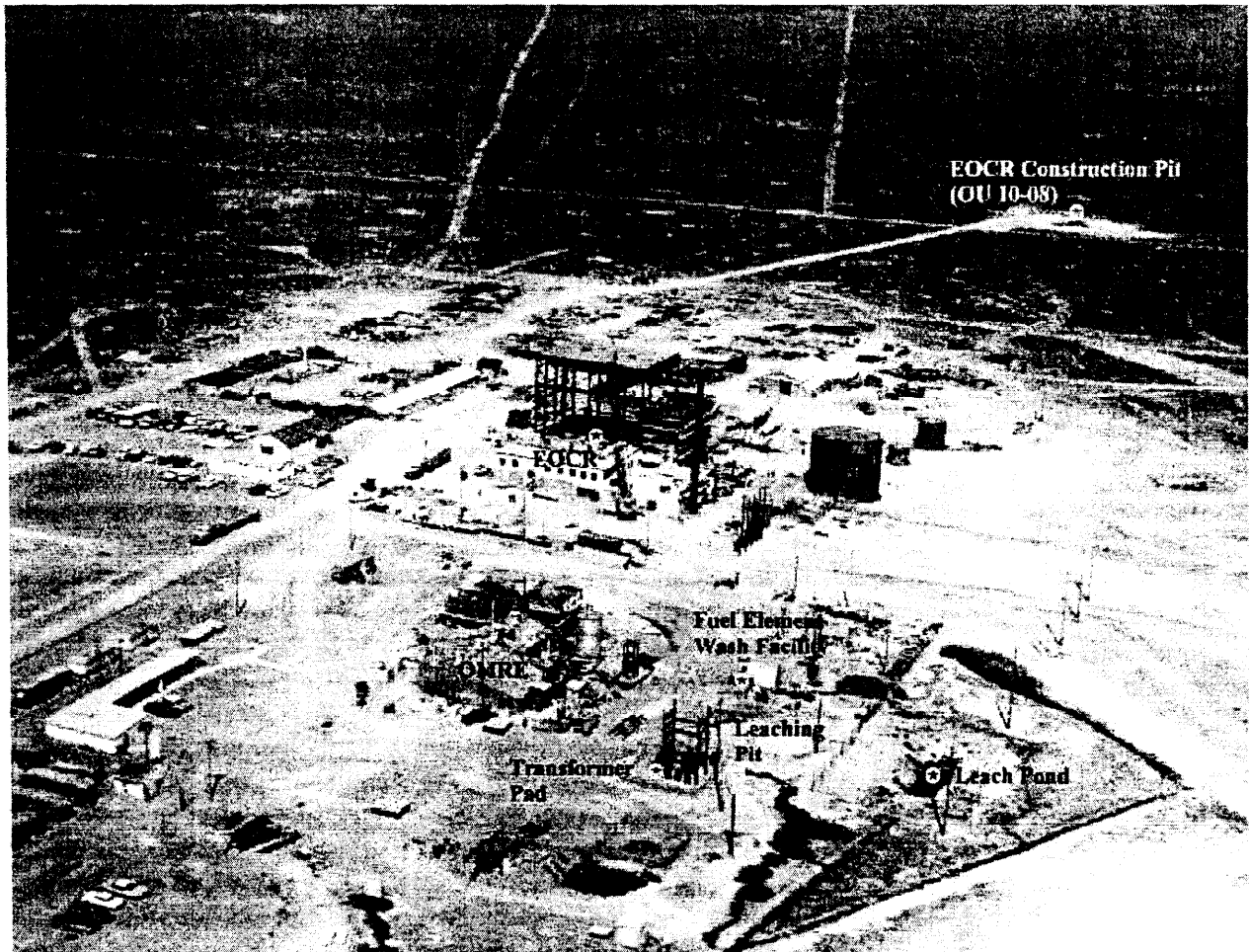


Figure 11-1. Aerial view of the OMRE and EOCR area in 1961.

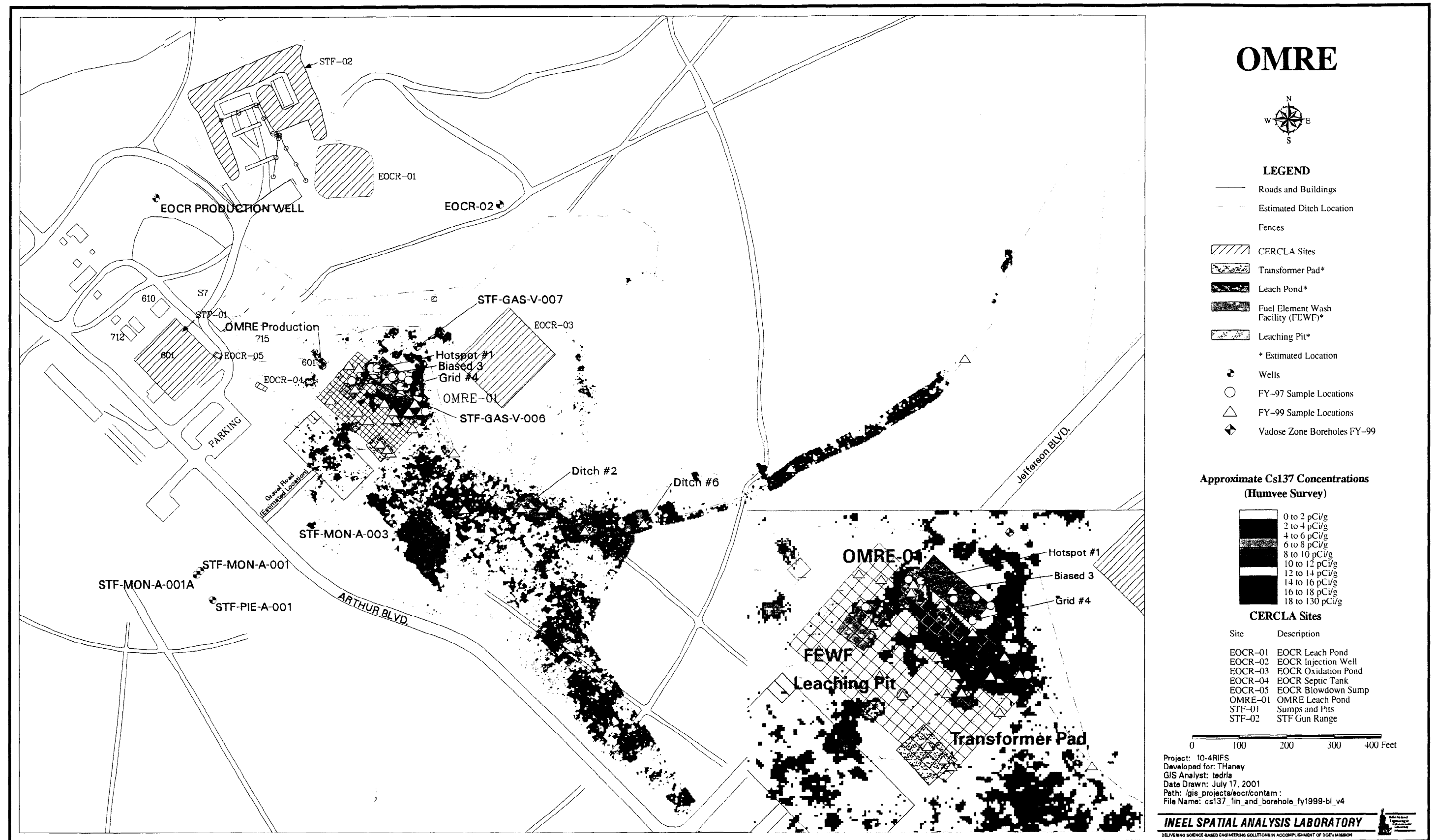


Figure 11-2. OMRE area wells, recent sampling locations, and radiometric scanning survey results.

The 1997 investigation discovered the presence of organic vapor contamination in the vadose zone and discovered radionuclide-contaminated soil and stained soil in a nearby ditch. The passive soil-gas survey indicated that several VOCs, including 1,1,1-TCA, were present in the subsurface, however, the survey system was only a qualitative screening device. Metals concentrations in the soil samples appeared to be naturally occurring. A single sample collected for toxicity characteristic leaching procedure (TCLP) metals analysis showed all nondetections, except for barium, which was below the TCLP limit. Both surface and subsurface soils indicated radionuclide contamination due to Co-60, Cs-137, Pu-239/240, Sr-90, and U-234/238, with Cs-137 having the highest concentration at 240 ± 7.7 pCi/g. Darkened soil was also observed in 1997, which was initially thought to be charcoal and possibly associated with an archaeological site. The material was determined not to be charcoal, but resembled degraded asphalt and was suspected to be an organic contaminant possibly containing polychlorinated biphenyls (PCBs).

Following the 1997 field season, the Agencies (i.e., U.S. Department of Energy Idaho Operations Office [DOE-ID], U.S. Environmental Protection Agency [EPA], and Idaho Department of Environmental Quality [IDEQ]) decided that additional definitive data were required to fill the data gaps at this site. Field activities were performed according to the Field Sampling Plan (FSP) (DOE-ID 1999). A detailed discussion of the OMRE sampling in 1999 and 2000 is located in Appendix J. The decision was also made to initiate quarterly monitoring of several area groundwater wells for at least two years, which will end in 2001. After the 1997 sampling was complete, photographs from several years in the early 1960s were discovered that showed ongoing liquid releases occurring from two facilities outside the OMRE Leach Pond. The radionuclide-contaminated soil in this location was previously assumed to be windblown and therefore, limited to the top few inches of soil. If the liquid releases had been contaminated, then the assumption that the contamination was surficial would probably have been in error. Further research led to "as-built" drawings showing that the releases had been coming from facilities that had been called (1) The Fuel Element Washing Facility, and (2) the Leaching Pit, both of which suggested that contamination could have been present in the liquid releases. The former locations and flow paths of these facilities were assessed in 1999 to determine the nature and extent of contamination related to these facilities. The historic photographs also showed a former transformer pad area, which was sampled in 2000 to determine whether PCBs were present in the soil, that might change cleanup options.

The 1999 and 2000 characterization projects were undertaken to fill data gaps left after the 1997 activities. The 1999 and 2000 activities included three major components.

1. The first major component included data collection from the surface soil above the basalt. During this activity, surface soils in and near the former OMRE leach pond, the fuel element washing facility, the leaching pit, and the associated ditches were field-screened and sampled for radionuclides, organic compounds, and PCBs. Surface soil radiological results are described in Appendix J. Surface soil organic compound results, including PCBs, are also described in Appendix J. In addition, during coring activities, the project geologist evaluated the surface soils and this evaluation is included in Appendix J.
2. The second major component included drilling coreholes into the basalt and both field-screening and sampling the vadose zone, specifically within a 21-m (70-ft) interbed, for radionuclides and organic compounds. Interbed sediment results are presented in Appendix J.
3. The third major component included drilling monitoring wells to the aquifer and sampling the groundwater for radionuclides and organic compounds. Appendix J contains these groundwater results.

In conjunction with soil sampling and laboratory analyses, three field measurement systems were deployed at OMRE to help characterize the extent of gamma-emitting, radionuclide-contaminated surface soil. The first field measurement system, the global positioning radiometric scanner, used an onboard computer that recorded global positioning and radiometric data. The global positioning radiometric scanner's radiation detection system was used over a 6.4-hectare (15.8-acre) area to quantify and map the distribution of gamma-emitting radioactive contamination in the surface soils. The map of the OMRE area, generated using data from the global positioning radiometric scanner (see Figure 11-2), showed mostly Cs-137 in the top few inches of soil. The second field measurement system, an aboveground, tripod-mounted germanium (Ge) spectrometer, made use of the global positioning radiometric scanner map by setting up in the areas identified as having elevated gamma-ray activity. The aboveground field measurement system used the U. S. DOE Environmental Measurement Laboratory MI® software package for spectral analysis. The locations with elevated gamma-ray activity in the OMRE ditch were targeted for corehole sampling (discussed in Appendix J) from the surface soil down to the soil/basalt interface. The third field measurement system, a downhole Ge spectrometer, made use of these coreholes and other deeper holes drilled in the area to help assess the vertical extent of radionuclide-contaminated soil. The results of these aboveground and downhole in situ measurements are summarized in Section 11.3.

A combination of field-screening and soil sampling with laboratory analytical techniques was used to characterize the OMRE soils for organic compounds. In summary, every corehole drilled in the OMRE area in 1999 was field-screened for organic vapor using an air pump and a photoacoustic analyzer (aka, B&K). Additionally, soil in selected locations in the coreholes was sampled and sent to the laboratory for SVOC and VOC analyses. Also, grab samples of stained soil in the OMRE ditch and samples from a former transformer pad location were collected and sent to the laboratory for analysis. The results are discussed in detail in Appendix J.

11.3 Nature and Extent of Contamination

Several characterization events have occurred at OMRE since it was shut down in 1963. Four physical features known or surmised to be contaminated have been sampled since that time. These physical features include the surface soil, the basalt bedrock, the two sedimentary interbeds, and the aquifer. When Comprehensive Environmental Response Compensation, and Recovery Act (CERCLA) sampling began in 1997, the soil was known to be contaminated with low concentrations of radionuclides. The other physical features (e.g., the basalt, sedimentary interbeds, and aquifer) were surmised to be potentially contaminated from the flow of liquid waste releases between 1957 and 1963. At the former OMRE leach pond, in a series of nearby ditches and in other potential release areas, WAG 10 used a variety of methods, including field-screening, soil-gas sampling, and soil and groundwater sample collection with laboratory analysis, to investigate the four physical features for radionuclides, metals, organics, and PCBs. Figure 11-2 shows the OMRE area, including wells, recent sampling locations, and the radiometric scanning survey results. Appendix J provides more extensive details of the methods and results of the CERCLA characterization.

The following information summarizes what is currently known about contamination in the soil, the basalt, the sedimentary interbeds, and the aquifer.

- Soil—Radionuclide-contaminated soil is present in the OMRE area, and Cs-137 is the most abundant radionuclide. Other radionuclides, such as Sr-90, Co-60, and Pu-239, are also present, but in lower concentrations. A high percentage of the soil contamination is in the top 0.61 m (2 ft), except in the location of the former OMRE leach pond where contamination is present at depths down to the soil/basalt interface at approximately 1 to 4 m (3 to 13 ft) deep. The surficial contamination outside the former pond is scattered near the

pond and present in a nearby ditch, but is localized in spots that are generally less than about 0.61 m (2 ft) in diameter. The highest concentration of Cs-137 observed at OMRE (240 ± 8 pCi/g) was measured in a biased sample collected from about 10 cm (4 in.) deep from one of these localized spots near the pond. In the pond subsurface, the highest concentration of Cs-137 (156 ± 5 pCi/g) was observed at the 0.91 to 1.8 m (3 to 6 ft) depth. Also observed at OMRE, in stained surface soil from a ditch, were the compounds chrysene and aroclor-1254, which were detected at concentrations of approximately $2.55 \text{ E}+06$ and $6.2 \text{ E}+01$ $\mu\text{g/kg}$ (ppb), respectively. Although more stained soil of this type may be present, the field team reported that only a small amount was apparent and that the entire amount they could find was required for the analyses. Although a passive soil-gas survey completed in 1997 showed the presence of several VOCs (chiefly 1,1,1-TCA) as vapor in the surface soil, neither the soil sampling and laboratory analysis nor the active soil-gas surveys completed in 1999 verified their presence. No other sampled contaminants were detected or known to be present in the surface soil.

- **Soil**—In addition to the liquid release area, the OMRE ditch was both field-screened and sampled in 1999. Figure 11-2 shows the field-screening results in which elevated gamma radiation was detected. From each of these “hot spots” shown on the map, soil corings were collected down to the depth where basalt was reached. The laboratory results from the ditch soil core samples show radiological contamination is present in these locations, this contamination exceeds the Risk Based Concentration (RBC) for Cs-137 (23 pCi/g) that was given in a January 3, 1996, letter from Jeff Fromm (Idaho Department of Health and Welfare [IDHW], now Idaho Department of Environmental Quality [IDEQ]) letter for the $1\text{E}-06$ 100-year residential scenario. In general, uncontaminated soil surrounds these ditch hot spot locations. The hot spots appear to be less than 2 ft in diameter with contamination highest in the top foot of soil, including Cs-137 concentrations as much as approximately 100 ± 8 pCi/g.
- The results from the biased data collected from the fuel element washing facility and the leaching pit areas support eliminating these sites as sources. Although some surface radiological contamination was present in a number of samples, neither the biased sampling locations that were chosen to pinpoint the former locations of these facilities nor the random grid sample locations showed evidence of elevated contamination over what was detected in the general OMRE pond area, and little was detected at depth. If these facilities were sources of radionuclide-contaminated soil at one time, the soil has been disturbed, sampling missed the localized areas of elevated concentrations, or it was low level to begin with and has decayed to below detectable levels. The only biased sample location that showed evidence of elevated contamination at the soil/basalt interface was located near the center of the former OMRE Leach Pond.
- **Basalt**—A sequence of basaltic lava flows and sedimentary interbeds underlies the OMRE. The thickness of the basalt to the aquifer is approximately 152 m (500 ft). The technology used in this project to assay the basalt for radionuclides was gamma logging, which was completed during well drilling. The gamma logging allowed an assay of gamma-emitting radionuclides. During this assay, the radioactive daughter products related to the decay of natural uranium and thorium were detected in typical background concentrations, but no manmade gamma-emitting radionuclides were detected in the basalt. On several occasions during well drilling, soil gas was collected for VOC analysis onsite with a photoacoustic analyzer. Although all the results were nondetects, the large volume of air used during drilling may have forced any VOCs into the basalt formation.

- **Sedimentary interbeds**—Near-surface interbeds are present beneath OMRE at depth ranges of approximately 21 to 23 m (70 to 75 ft) and 41 to 45 m (136 to 146 ft). On the premise that the interbeds could have trapped some contaminants from OMRE releases, WAG 10 collected core samples of the sediment from the 21 to 23 m (70 to 75 ft) interbed for radionuclide and SVOC/VOC laboratory analyses, completed gamma logging of the well, and then fit vapor ports in the interbeds for soil gas monitoring. No perched water was encountered in any of the interbeds. The radionuclide analyses of sediments showed the presence of naturally occurring uranium and thorium in all the sediments and a trace of Sr-90 (1.11 ± 0.15 pCi/g) in one sample. The SVOC/VOC analyses of sediments showed traces of xylene, ethylbenzene, and acetone in one sample at maximum concentrations of 46, 15, and 44 µg/kg (ppb), respectively. The gamma logging showed no elevated radioactivity deeper than the soil/basalt interface. Naturally occurring radionuclides were present in subsurface rock and soil in concentrations observed in regional rocks and soils. The initial vapor port logging was completed soon after drilling was inconclusive because the air and heat of drilling may have affected the results. However, during the first round of the quarterly vapor port monitoring in August 2000 (nearly a year after drilling), the compound 1,1,1-TCA was detected in soil gas pulled from the 21 m (70 ft) interbed at a maximum concentration of approximately 190 ppm. Vapor port monitoring is ongoing.
- **Aquifer**—Samples have been collected from several area wells to assess potential impacts from OMRE, including the Badging Facility Well, United States Geological Survey (USGS) Well 107, STF-MON-A-01A, STF-MON-A-02A, STF-MON-A-003, and STF-MON-A-004. Groundwater was analyzed for radionuclide and organic compounds. No radionuclides other than naturally occurring ones have been detected. Traces of the compound 1,1,1-TCA were detected in samples collected from STF-MON-A-003 in concentrations of 1.7 and 1.8 µg/L. This same compound is reported sporadically and at very low levels (averaging about 1.1 µg/L) in samples collected from the Badging Facility Well, WAG 4 wells, and other wells across the INEEL. These groundwater data are not likely to mean that the INEEL has multiple isolated 1,1,1-TCA plumes. Although the source is unknown, it is more likely that these 1,1,1-TCA detections are related to other causes such as laboratory contamination or sampling equipment. However, because 1,1,1-TCA has also been detected in OMRE soil gas, quarterly groundwater monitoring was initiated in 2000 from the following wells: the Badging Facility Well, STF-MON-A-003, STF-MON-A-004, STF-MON-A-01A, and STF-MON-A-02A. Planned for a two-year duration, the first quarter of this monitoring resulted in nondetects for all compounds of interest.

11.4 Preliminary Screening

The soil data collected from the 1997, 1999, and 2000 field sampling efforts were screened for contaminants of potential concern (COPCs). The results of that screening process are presented in Tables 11-1 and 11-2. The human health risk assessment (HHRA) and ecological risk assessment (ERA) screening methodology is discussed in Section 4 and presented in detail in Appendices D and F, respectively. Because the maximum concentrations exceeded the RBCs, Ra-226, Cs-137, benzo(a)pyrene, and chrysene were retained as COPCs for the HHRA. Methacrylonitrile was retained as a COPC for the ERA, however, because EBSLs were not established for this contaminant, it could not be assessed. Chrysene, lead, and selenium were retained after the preliminary screen because the maximum site concentrations exceeded the EBSLs.

Table 11-1. Soil contaminant screening process for OU 10-02, OMRE-01 soils (1997, 1999, 2000) — nonradionuclides.

Detected Contaminants	Step 1		Step 2		Step 3		Step 4		Site COPC	
	Max Source Concentration (mg/kg)	INEEL Background Concentration (mg/kg)	Max Concentration > Background	Nontoxic Metal?	Region 9/3 RBC (mg/kg)	Max Concentration > RBC	INEEL EBSL (mg/kg)	Max Concentration > EBSL	HHRA	ERA
Benzo(a)pyrene	2.60E-01	NA	NA	No	6.20E-02	Yes	2.69E+00	No	Yes	No
Chrysene	2.70E+03	NA	NA	No	6.20E+01	Yes	2.69E+00 ^a	Yes	Yes	Yes
Lead	2.32E+01	1.70E+01	Yes	No	4.00E+02	No	9.94E-01	Yes	No	Yes
Methacrylonitrile	5.00E-03	NA	NA	No	2.06E+00	No	No EBSL	No EBSL	No	Yes
Selenium	2.90E-01	2.20E-01	Yes	No	3.91E+02	No	1.72E-01	Yes	No	Yes

Source: WAG 10, OU 10-04 Database.

"NA" in Step 1 indicates that a background value is not available.

"No EBSL" indicates that an INEEL ecologically based screening level is not available.

a. The EBSL for benzo(a)pyrene was used to evaluate chrysene because of their similar chemical properties and because benzo(a)pyrene is a more toxic polycyclic aromatic hydrocarbon (PAH).

Table 11-2. Soil contaminant screening process for OU 10-02, OMRE-01 soils (1997,1999) —radionuclides only.

Detected Contaminants	Step 1		Step 2		Step 3		Step 4		Site COPC	
	Max Source Concentration (pCi/g)	INEEL Background Concentration (pCi/g)	Max Concentration > Background	Nontoxic Metal?	Region 9/3 RBC (pCi/g)	Max Concentration > RBC?	INEEL EBSL (pCi/g)	Max Concentration > EBSL?	HHRA	ERA
Cs-137	2.40E+02	8.20E-01	Yes	No	2.30E-01	Yes	4.95E+03	No	Yes	No
Ra-226	4.94E+00	NA	NA	No	5.50E-03	Yes	2.04E+01	No	Yes	No
U-235	2.74E-01	NA	NA	No	1.30E-01	Yes	2.27E+01	No	Yes	No

Source: WAG 10, OU 10-04 Database.

"NA" in Step 1 indicates that a background value is not available.

The radionuclide Ra-226 was eliminated at this point in the HHRA, because the sample concentrations were comparable to the background levels in this area. Because Ra-226 is a daughter product of naturally occurring U-238, it is rarely produced by human activities. Additionally, Ra-226 is neither a fission byproduct nor is it an activation product. The Ra-226 discussed here is a naturally occurring radioactive material (NORM) and was not a product of any known operational discharges. The detected concentrations of Ra-226 were found in numerous depth intervals with no indication of a hot spot. The samples taken in 1997 and 1999 were analyzed using gamma spectrometry, which is typically biased high (Giles 1998). This bias is caused by interference from gamma rays emitted by U-235. During the data validation of the OMRE-01 samples in 1997 and 1999, the laboratories indicated that the results for the Ra-226 samples were "J" flagged (meaning the result was an estimation). This estimation was based on the laboratory narrative indication that potential spectral interference from U-235 exists for the sample (TWM-95-99).

Correction of the Ra-226 data can be accomplished by calculating the individual Ra-226 and U-235 contributions to the composite gamma ray peak in the gamma ray spectrum. This calculation is based on the Giles, (1998) discussion. The correction factor for the Ra-226 data sets, obtained by gamma-ray spectroscopy, is 0.571. This factor removes the U-235 contribution to the observed gamma ray signal, and reduces the inaccurate and high Ra-226 concentrations by approximately 43% (Giles 1998). Applying the correction factor to the OMRE-01 data set reduces the average Ra-226 concentrations from 2.49 pCi/g to 1.42 pCi/g, and the maximum concentration of 4.94 pCi/g is reduced to 2.82 pCi/g (see Table 11-3). There is limited documentation on the background concentrations of radium and other naturally occurring radioactive materials at the INEEL. However, Rood et al. (1996) presented a summary of radionuclide concentrations for the INEEL. This summary reports a Site-wide U-238 background concentration upper tolerance limit (UTL) of 1.85 pCi/g and 2.15 pCi/g at the 95% and 99% confidence intervals, respectively. The U-238 is a good determiner of risk because Ra-226 is a naturally occurring radionuclide in the U-238 decay chain, and the activity of the daughter, Ra-226, is equivalent to that of the parent, U-238. The corrected average Ra-226 concentrations in Table 11-3 are less than the UTLs for U-238 and its progeny (Rood et al. 1996).

In conclusion, when the bias from U-235 is removed from the Ra-226 data set, it is comparable to background concentrations found at the INEEL. When the corrected average concentration for Ra-226 (1.42 pCi/g) is compared to the corrected, average INEEL background Ra-226 concentration of 1.2-pCi/g (from the two background data sets shown in Table 1 from Giles [1998], there is no significant difference. The naturally occurring levels of Ra-226 found at OMRE-01 pose only a marginal human health risk due to external exposure over a 30-year period.

Table 11-3. Corrected Ra-226 concentrations.

	Reported Ra-226 Concentrations (pCi/g)			Corrected Ra-226 Concentrations (pCi/g)		
	Bkg. 1 (Giles, 1998)	Bkg. 2 (Giles, 1998)	OMRE-01	Bkg. 1 (Giles, 1998)	Bkg. 2 (Giles, 1998)	OMRE-01
Average Concentration	2.14	2.12	2.49	1.22	1.21	1.42
Minimum Concentration	0.67	0.79	1.33	0.38	0.45	0.76
Maximum Concentration	4.54	3.85	4.94	2.59	2.20	2.82

11.5 Risk Assessment

Table 11-4 presents the exposure point concentrations (EPCs) for OMRE-01. Appendix C contains both summary statistics and EPCs.

11.5.1 Human Health

To perform the HHRA, it was necessary to develop EPCs evaluation based on the different scenarios. Due to the character of the OMRE data, the sampled data were evaluated for hot spots before calculating the EPC. An area containing elevated *contaminant concentration* or *activity concentration* relative to the surrounding area is a hot spot. Since the EPC is an indication of average contamination across the site, hot spots should be eliminated from the EPC calculation.

Evaluation of Small Areas of Elevated Activity . As discussed in Section 11.2, surface and subsurface sampling of the OMRE soils occurred in 1997, 1999, and 2000. The OMRE leach pond, leaching pit, and ditches were also field screened (with the global positioning radiometric scanner unit). The results of these surveys and sampling are shown in Figure 11-2. Three samples and a duplicate were identified by the 1997 and 1999 sampling as areas of elevated activity in accordance with the MARSSIM manual (EPA 2000). These included two locations in the pond sampled in 1997, including sample locations called Hot Spot #1 (240 pCi/g taken at 0.33 to 1.0 ft depth, 1997) and Grid #4 (156 pCi/g taken at 3 to 6 ft depth, 1999), and a duplicate at Grid # 4 (134 pCi/g taken at 3 to 6 ft depth). Sampling during 1999 identified a hot spot in one of the ditches, sample location called Ditch #2 (100 pCi/g taken at 0.25 to 0.7 ft depth, 1999). Following is a detailed discussion of these sites.

In general, sampling indicates that uncontaminated soil surrounds all the ditch hot spot locations (including Ditch #2). Also, for the 1999 sampling, soil corings were collected down to the depth where basalt was reached at this same location and contamination was not encountered. It also appears from evaluation of the extensive sampling in the pond that the surface hot spots are less than 2 ft in diameter and are not deep except for Hot Spot #1, as discussed below.

Table 11-4. Summary exposure point concentrations for OMRE-01 soils. (EPC units are mg/kg or pCi/g; Bin depths are in feet).

COPC	0–0.5 ft	0–4 ft	0–10 ft
Benzo(a)pyrene	1.66E-01	2.08E-02	8.30E-03
Chrysene	2.55E+03	3.19E+02	1.28E+02
Lead	1.85E+01	1.56E+01	1.45E+01
Methacrylonitrile	3.75E-03	ND	ND
Selenium	2.83E-01	2.86E-01	3.39E-01
Cs-137	3.63E+01	1.22E+01	1.43E+01
Ra-226	2.21E+00	2.19E+00	2.20E+00
U-235	6.69E-02	6.34E-02	6.81E-02

ND = non detected

Table 11-5 presents the 13 out of approximately 142 samples that have Cs-137 levels over 23.3 pCi/g.

Table 11-5. Samples at OMRE with Cs-137 over 23.3 pCi/g.

Sample Number	Area	Location	Sample Date	Compound Name	Concentration (pCi/g)	Sample Depth (ft)
OMV01701R4	#5	DITCH	7/26/1999	Cs-137	22.3 ^a	0-0.66
OMR030019R	LEACH POND	GRID #4	7/22/1997	Cs-137	22.5 ^a	1-3
OMR009019R	NAI LOCATION	HOT SPOT #2	7/28/1997	Cs-137	23.3	0.33-1
OMR019019R	DOWN GRADE	DITCH	7/16/1997	Cs-137	27	0.33-1
OMR005029R	NAI LOCATION	HOT SPOT #1	7/28/1997	Cs-137	29.8	1-3
OMR005019R	NAI LOCATION	HOT SPOT #1	7/28/1997	Cs-137	35.7	1-3
OMV02101R4	#6	DITCH	7/26/1999	Cs-137	36.3	0-0.5
OMS08201R4	POND	BIASED 3	8/4/1999	Cs-137	41.2	7.7-8.9
OMR018019R	DOWN GRADE	DITCH	7/16/1997	Cs-137	57.4	0-0.33
OMV00601R4	#2	DITCH	7/26/1999	Cs-137	100	0.25-.075
OMR031029R	LEACH POND	GRID #4	7/22/1997	Cs-137	134	3-6
OMR031019R	LEACH POND	GRID #4	7/22/1997	Cs-137	156	3-6
OMR004019R	NAI LOCATION	HOT SPOT #1	7/28/1997	Cs-137	240	0.33-1

a. Concentrations overlap 23.3 at the 95% confidence interval.

Table 11-6 presents the multiple samples taken at different depths at the Hot Spot #1 location. This table indicates that the concentration found at the 0.33 to 1 ft depth decreases significantly at the 1 to 3 ft depth (primary and duplicate samples, 29.8 pCi/g and 35.7 pCi/g). Hot Spot #1 is the only surface hot spot that shows contamination of concern at greater than surface depths.

Table 11-6. Cs-137 concentrations in certain samples taken at Hot Spot # 1 location.

Sample Number	Area	Location	Sample Date	Compound Name	Concentration (pCi/g)	Sample Depth (ft)
OMR007019R	NAI LOCATION	HOT SPOT #1	7/28/1997	Cs-137	2.18	6-6.75
OMR003019R	NAI LOCATION	HOT SPOT #1	7/28/1997	Cs-137	3.22	0-0.33
OMR006019R	NAI LOCATION	HOT SPOT #1	7/28/1997	Cs-137	3.9	3-6
OMR005029R	NAI LOCATION	HOT SPOT #1	7/28/1997	Cs-137	29.8	1-3
OMR005019R	NAI LOCATION	HOT SPOT #1	7/28/1997	Cs-137	35.7	1-3
OMR004019R	NAI LOCATION	HOT SPOT #1	7/28/1997	Cs-137	240	0.33-1

Table 11-7 presents the samples taken at the Biased 3 location (sampled in 1999). The highest detection is 41.2 pCi/g at 7.7 to 8.9 ft. This sample is in the center of the pond. The other five samples taken at this location at various depths are nondetects (identified as "U" or "UJ"). As shown in Table 11-8, the downgrade ditch (sampled in 1997) has detections at two lowest depths (0 to 1 ft) and then decreases to below 2.27 pCi/g.

Table 11-7. Cs-137 concentrations in certain samples taken at Biased 3 location.

Sample Number	Area	Location	Sample Date	Compound Name	Concentration (pCi/g)	Sample Depth (ft)	Detection
OMS08602R4	POND	BIASED 3	8/4/1999	Cs-137	-0.014	3-3.5	U
OMS07901R4	POND	BIASED 3	8/4/1999	Cs-137	0.0126	0.33-1	U
OMS08101R4	POND	BIASED 3	8/4/1999	Cs-137	0.0177	5.5-6	U
OMS08001R4	POND	BIASED 3	8/4/1999	Cs-137	0.0611	1-3	U
OMS07801R4	POND	BIASED 3	8/4/1999	Cs-137	0.0679	0-0.33	UJ
OMS08201R4	POND	BIASED 3	8/4/1999	Cs-137	41.2	7.7-8.9	

Table 11-8. Cs-137 concentrations in certain samples taken downgrade of the ditch at OMRE.

Sample Number	Area	Location	Sample Date	Compound Name	Concentration (pCi/g)	Sample Depth (ft)
OMR020019R	DOWN GRADE	DITCH	7/16/1997	Cs-137	1.61	1-3
OMR021019R	DOWN GRADE	DITCH	7/16/1997	Cs-137	2.27	3-5.75
OMR019019R	DOWN GRADE	DITCH	7/16/1997	Cs-137	27	0.33-1
OMR018019R	DOWN GRADE	DITCH	7/16/1997	Cs-137	57.4	0-0.33

The Cs-137 soil contamination at Hot Spot #1 was modeled for external exposure using RESRAD 6.0 under two scenarios. The first was the current occupational scenario. Under this model, the maximum concentration of 240 pCi/g from Hot Spot #1 was used. The concentration was assumed to be uniformly distributed throughout the contaminated volume. The current worker was assumed to spend 100 percent of the time directly in the contaminated area. No shielding factors were used. The assumptions included:

Area of contamination: 1 m²

Thickness of contaminated soil: 1 m

Soil concentration: 240 pCi/g

Occupancy: 1.0 (100% of the time)

This scenario resulted in a modeled maximum external exposure of 82.5 mr/y, as seen in Figure 11-3 below.

The second scenario modeled a residential occupant 100 years in the future. All of the assumptions for this scenario were the same as the current occupational scenario except the soil concentration of Cs-137. The soil concentration for the Cs-137 was decayed to match the date 100 years in the future.

This lowered the source term of Hot Spot #1 from 240 pCi/g to 24.14 pCi/g. This is the starting soil concentration for the residential scenario. Again, the future resident is assumed to spend 100 percent of their time in the contaminated area with no shielding. This scenario resulted in a modeled maximum external exposure of 8.3 mrem/y, as seen in Figure 11-4. Comparing the graphs for the two scenarios, it can be observed that the exposure value at the 100-year mark corresponds identically.

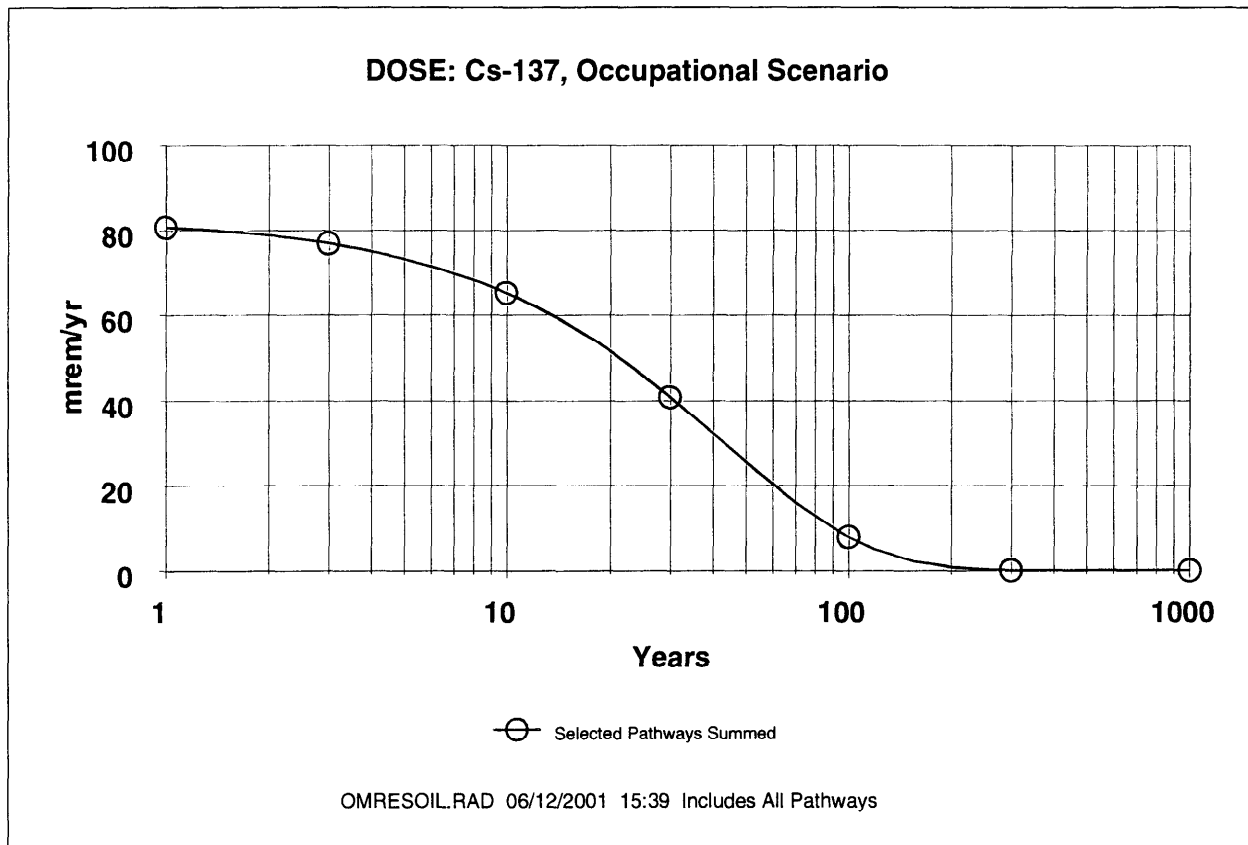


Figure 11-3. Modeled external exposure to Cs-137 at OMRE Hot Spot #1 under current occupational scenario.

In conclusion, the general overview of this site is that surface soil contamination does exist (Hot Spot #1), is typically associated with hot spots, is limited in extent, and is Cs-137 (as shown by the preliminary screening). It is also apparent from the random subsurface sampling (Grid #4) that some of the old berm may still exist and contain some contamination at the 3 to 6 ft depth or at greater depths. This is only identified in two samples. Limited contamination exists in the ditch area, is not extensive, and most may have been sampled and then removed in the sampling process.

Risk Evaluation—Based on the EPC as presented in Table 11-4, the total estimated carcinogenic risk for potential future residents at OMRE-01. The total estimated carcinogenic risks results are presented in Table 11-9. It can be seen that the primary risk driver is the external exposure pathway due to the Cs-137 concentration. The external dose falls within the target risk range of 1E-04 to 1E-06. The primary contributor to risk is Cs-137, with a value of 6E-05 through the external radiation exposure route. Noncarcinogenic hazards to future residents were not evaluated due to the lack of reference doses for benzo(a)pyrene and chrysene.

The total risk to current occupational workers at OMRE-01 is $1\text{E-}04$, through the external radiation exposure route to Cs-137. Noncarcinogenic risks to current workers were not evaluated due to the lack of reference doses for benzo(a)pyrene and chrysene.

The total risk to future occupational workers at OMRE-01 is $2\text{E-}05$, through the external radiation exposure route to Cs-137. Noncarcinogenic hazards to future workers were not evaluated due to the lack of reference doses for benzo(a)pyrene and chrysene.

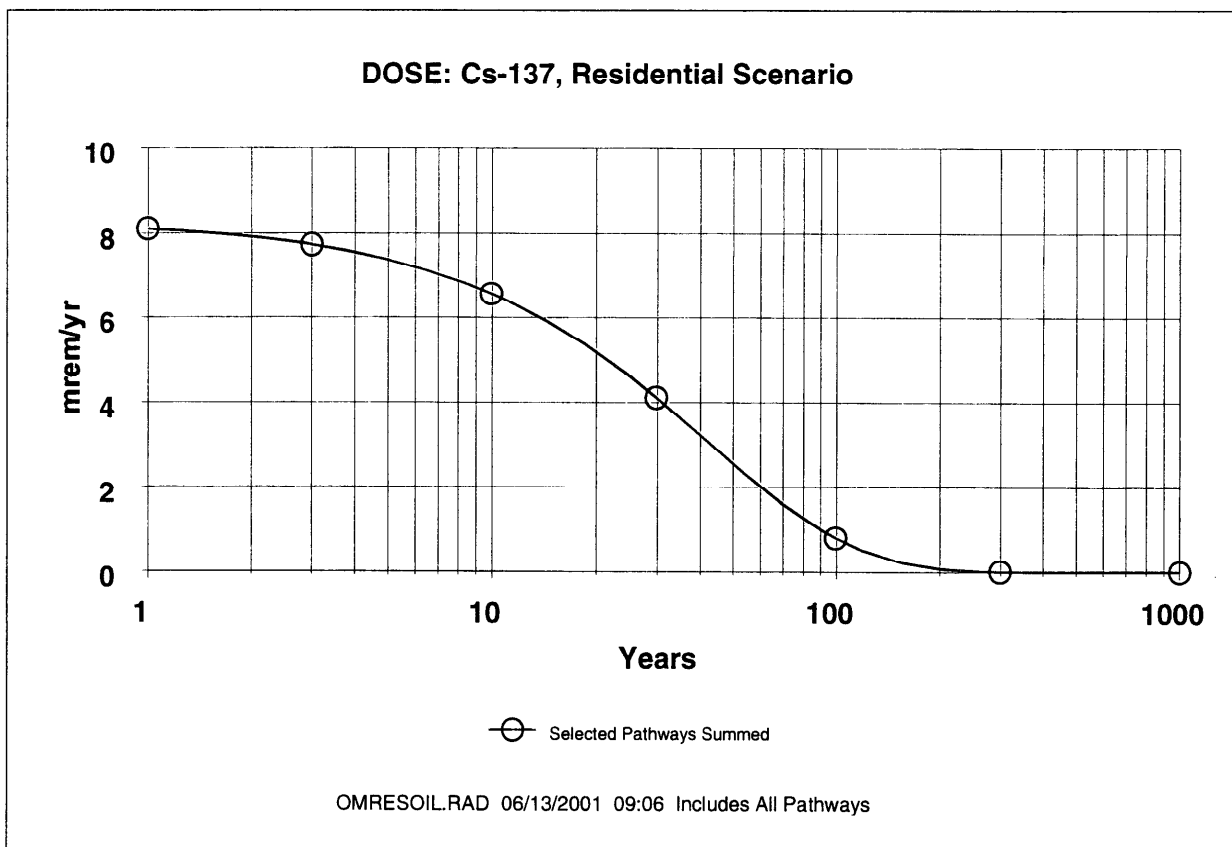


Figure 11-4. Modeled external exposure to Cs-137 at OMRE Hot Spot #1 under future residential scenario.

Table 11-9. Total Risks by Exposure Pathway at each site/area (Residential).

Scenario	Ingestion of Soil	Ingestion of Groundwater	Ingestion of Homegrown Produce	Inhalation of Fugitive Dust	Inhalation of Volatiles from Soil	Inhalation of Volatiles from Groundwater	External Radiation Exposure	Dermal Absorption of Soil	Dermal Absorption of Groundwater	Total by site/area
Resident'l	4E-06	4E-07	4E-06	4E-09	—	—	6E-05	2E-05	8E-07	9E-05
Future Worker	4E-06	NC	NC	3E-09	Not Calculated (NC)	NC	1E-05	6E-06	NC	2E-05
Current Worker	4E-06	NC	NC	3E-09	NC	NC	1E-04	6E-06	NC	1E-04

In addition, the RESRAD results showed negligible radiation levels for the 100-year future residential scenario.

Complete HHRA results are presented in Appendix E.

11.5.2 Ecological

The COPCs for the ERA are radionuclides, metals, and inorganics for surface and subsurface soils. Radionuclides were eliminated during the EBSL screening (see Table 11-2). The COPCs which remained following the screening process were chrysene, lead, methacrylonitrile, and selenium. Risks from exposure to reptiles, amphibians, and invertebrates to these contaminants could not be evaluated due to the lack of toxicity data. A preliminary estimation of HQs, including chrysene, is provided in Appendix F. Upon further evaluation of the sampling results and review of field team notes, chrysene was eliminated from the ERA since surface soil sampling removed the elevated soil result of 2500 mg/kg, and all available sample material was used for the analysis. Methacrylonitrile was among the COPCs, but no toxicity information could be found to assess ecological risk. This compound was considered a low risk because its maximum concentration was 0.0037 mg/kg, and it is volatile and not likely to persist in dry soils. Methacrylonitrile is no longer considered a COPC because significant risk is not expected to occur from exposure to this contaminant. The ERA HQs for the COPCs at OMRE-01 are discussed below.

- Lead HQs at OMRE-01 were all below 1.0.
- Selenium HQs at OMRE-01 were all below 1.0.

The risk evaluation indicates that OMRE-01 has limited risk to ecological receptors from exposure to soils from this site. No COPCs were retained for further evaluation in the ERA for OMRE-01.

Complete ERA results are presented in Appendix F.

11.5.3 Native American

The INEEL is within the aboriginal territories of the Shoshone-Bannock Tribes. A wide variety of natural and cultural resources and areas that directly reflect tribal cultural heritage and native landscape ecology are preserved on the INEEL. These resources are important in maintaining tribal spiritual and cultural values and activities, oral tradition and history, mental and economic well being, and overall quality of life. Appendix A contains a qualitative analysis of WAGs 6 and 10 prepared by the Shoshone-Bannock Tribal Risk Assessment Committee. General tribal concerns about the OMRE leach pond and other nearby release sites are summarized in Section 14.9.3.

11.6 Uncertainties

Two chief uncertainties exist for the OMRE site. One is related to the quantity and concentration of radionuclide contamination left buried in the OMRE leach pond berm, and the other is related to the organic vapor in the subsurface.

Complete characterization of the berm soil is not available. If, as suspected, the berm was not excavated with the other radionuclide-contaminated soil at the OMRE leach pond in 1979, then higher concentrations of Cs-137 that are reflected in sample data are likely to be present in the subsurface soil, and the risk could have been underestimated. However, the berm is buried under approximately 1 m (3.25 ft) of clean soil, and Cs-137 (i.e., the chief contaminant) is reported to have a high sorptive capacity

in soil. Therefore, any contaminated berm soil that may remain is not likely to migrate given the low rainfall and the high evaporation rate at the INEEL. In addition, Cs-137 is easily detected in situ with gamma ray detection equipment, and the readings depicted show Cs-137 to be near background levels over the OMRE leach pond location.

The organic vapor that is being monitored through vapor ports in the sedimentary interbeds is an uncertainty because OMRE has not been positively identified as its source. In addition, although organic vapors are detectable in the interbed soil gas, no free product has been observed. None of the compounds present as vapor were detected in interbed sediment samples sent for laboratory analysis. The organic vapor is to be monitored quarterly and evaluated for potential impact on groundwater.

In the human health risk assessment, noncarcinogenic hazard quotients, including dermal absorption risks, were not calculated due to the lack of RfDs for benzo(a)pyrene and chrysene. However, these COPCs were evaluated in the carcinogenic risk calculations for all scenarios.

To limit the amount of information repeated in individual uncertainty sections, only the specific uncertainties associated with each site or area will be discussed within its section. General uncertainties associated with the HHRA are found in Appendix D. General uncertainties associated with the ERA can be found in Appendix F.

11.7 Conclusions and Recommendations

Extensive characterization of this site was performed (see Section 11.3 and Appendix J). It is evident that radionuclide-contaminated soil is present in the OMRE area, and Cs-137 is the most abundant radionuclide. The global positioning radiometric scanning survey results and the aboveground and downhole in situ measurements have helped refine and confirm the OMRE conceptual model. The results show that a high percentage of the Cs-137 soil contamination is in the top 0.61 m (2 ft), except in the location of the former OMRE leach pond, where contamination is present at depths down to the soil/basalt interface at approximately 1 to 4 m (3 to 13 ft) deep. The surficial contamination outside the former pond is scattered near the pond and present in a nearby ditch, but is localized in small areas of elevated activity that are generally less than 0.61 m (2 ft) in diameter. Based on the discussion above, these areas were eliminated from the assessment. Contamination at the site is at levels corresponding to the 1E-04 to 1E-06 target risk range for human health, with external exposure to radionuclides and dermal exposure to organics (benzo(a)pyrene) as the greatest contributors, although the risk from dermal exposure is likely highly conservative based on the sampling discussion in Appendix J. Ecological risk is also considered to have limited risk based on the discussion above. Therefore, this site is recommended for no further action, and will not be evaluated in the feasibility study.

11.8 References

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